Biology

Mining with microbes: A labor of bug

Back in the days when forty-niners were miners, the gold bug drove folks mad for the motherlode. Today's Forty-Niners play football in San Francisco and dream of getting rich doing TV commercials. But the gold bug lives on in a new, improved form. Indeed, modern gold bugs *do* the mining themselves.

The bugs are bacteria, mostly strains of the naturally occurring *Thiobacillus ferrooxidans*. Science-savvy prospectors report increasing success using these single-celled slaves to retrieve gold, copper and other valuable minerals from otherwise unprofitable mines.

T. ferrooxidans has long thrived on mineral-rich rock. The bacteria oxidize sulfide-bound minerals and proliferate in the acidic solutions created when rainwater reacts with ore. Mining companies long viewed these microbes as pests because their metabolic munching unleashes sulfur-entrapped toxins such as cyanide and arsenic. But the process also releases quantities of valuable metals whose concentrations are too low to extract economically by traditional methods.

In recent years, scientists have taken advantage of these reactions by "seeding" heaps of ore with bacteria that release bound-up copper. Mining companies dispose of the toxic runoff but keep the copper. Now the technique has begun to show promise as a means of recovering gold, cobalt and uranium.

After studying 28 strains of *T. ferrooxidans* collected from mines around the world, researchers at the Idaho National Engineering Laboratory in Idaho Falls report they have isolated one variant that leaches out about 10 percent of the available cobalt from low-grade ore. Their experiments so far have been small in scale, within 3-foot-long tubes. But the method shows promise as an economical way to extract the metals, says Karl Noah, a senior engineer on the project. Both known cobalt deposits in the United States today remain unexploited because conventional methods of recovery have proved too expensive.

Cobalt is a critical ingredient in some metals that retain their strength at high temperatures, such as the alloys used in aircraft engine parts. If scale-up experiments funded by the U.S. Bureau of Mines confirm current projections, cobalt mining may become a matter of "sprinkling the bacteria on piles of ore that are 20 feet high and as long as you want," Noah says. After hosing down these heaps with acidified water, scientists can recover the cobalt-rich runoff and extract the mineral using traditional electrochemical methods.

A similar technique shows promise for mining refractory gold ores, in which gold is bound to iron and sulfur, says William Reid, president of the Denver-based U.S. Gold Corp. The company's newly constructed mill in Tonkin Springs, Colo., pretreats these ores with a strain of *T. ferrooxidans* to liberate the gold, which is then recovered by conventional methods. As easily extracted gold-oxide ores become depleted in the next few years, "bioleaching" will become increasingly commonplace among gold-mining operations, Reid and others predict.

Pseudomonas and Prince William Sound

Bacteria may have career prospects in the oil industry, too. Researchers have engineered a strain of *Pseudomonas aeruginosa* that secretes a soap-like material that enhances the removal of oil from gravel and other surfaces. In laboratory experiments performed on gravel retrieved from Alaska's Prince William Sound after last year's *Exxon Valdez* spill, the biodegradable surfactant removed three times the amount of oil washed away by plain warm water, commonly used by cleanup crews there. Steven Harvey of the U.S. Army Chemical Research, Development and Engineering Center in Aberdeen, Md., and his co-workers report the findings in the March BIO/TECHNOLOGY.

Biomedicine

Vietnam veterans sustain cancer threat

U.S. veterans of the Vietnam war face a 50 percent greater risk of developing non-Hodgkin's lymphoma — a deadly cancer of the lymph nodes — than men who did not serve in Vietnam, according to a new study. Vietnam veterans have a risk of 1.5 per 10,000, compared with a risk of 1 in 10,000 among controls, the researchers report.

The study, conducted by the Atlanta-based Centers for Disease Control and 12 U.S. research institutions, does not suggest a reason for the heightened risk. However, it does indicate that the incidence of this cancer, which strikes 35,600 people in the United States each year, cannot be linked to the dioxin-containing Agent Orange. Veterans' groups and some scientists contest that conclusion.

The researchers found that only one of 99 Vietnam veterans with non-Hodgkin's lymphoma reported handling Agent Orange sprayers, and none reported spraying the jungle defoliant. The risk pattern observed in the study group, they say, seems to argue against any link between Agent Orange and non-Hodgkin's lymphoma: Veterans serving on Navy ships off the coast of Vietnam had a higher risk of non-Hodgkin's lymphoma than land veterans, who got more exposure to Agent Orange.

But the study didn't assess Agent Orange exposure directly, argues John F. Sommer of the American Legion in Washington, D.C. Instead, the researchers used interviews with veterans to gauge their exposure — a method he calls unreliable.

The finding that Vietnam veterans who served at sea have a higher incidence of non-Hodgkin's lymphoma than land troops is probably a statistical fluke, contends epidemiologist Jeanne M. Stellman of Columbia University in New York City. Previous studies have shown that exposure to herbicides, such as Agent Orange, boost the risk of non-Hodgkin's lymphoma, she adds (SN: 9/13/86, p.167).

The researchers looked at five other cancers as well, finding that Vietnam veterans showed no more risk than men who had not served in Vietnam.

NMR test fails to identify cancer

A much-touted experimental technique cannot detect signs of cancer after all, scientists report.

In 1986, a study by Eric T. Fossel and his colleagues at Beth Israel Hospital in Boston generated excitement among researchers and physicians by suggesting that nuclear magnetic resonance (NMR) spectroscopy could identify telltale cancer clues in people's blood samples (SN: 12/6/86, p.356).

But in the April 5 NEW ENGLAND JOURNAL OF MEDICINE, two separate research teams report that NMR analysis cannot reliably distinguish between blood samples from people with cancer and those from healthy individuals. Both teams took the clear portion of the blood, or plasma, placed it in an NMR spectrometer, and studied the resulting NMR signal from the fat-containing lipoproteins.

Paul Okunieff of the Harvard Medical School in Boston led one study, while Terje Engan of Trondheim Hospital in Norway led the other. Both found that the NMR signals of people with cancer looked remarkably similar to those of healthy controls. Okunieff showed that NMR yields a false negative rate of 56 percent and a false positive rate of 52 percent.

"The NMR test for cancer has not fulfilled the great expectations that accompanied its initial description," writes Robert Shulman of the Yale University School of Medicine in an editorial accompanying the two reports. The discouraging results mean researchers must continue searching for a blood test that reliably homes in on cancer at an early stage, Okunieff told SCIENCE NEWS. Physicians could use such a test to monitor people at high risk of cancer so that early treatment could attack malignant cells before they spread, he adds.